AF Technologies

ManTech Lean Blade Repair Pilot
A Success Story

AFRL/ML R. Reed, DSN 784-4393

Technology Investment Schedule — As of 04 APR 2001

	Prior	01	02	03	04
Transition to OC-ALC/LP					
Technology Availability	▲				
Funding ($M) – PE78	5.3	0	0	0	0

Description

- Establish a low cost high quality “Lean” repair capability for advanced propulsion systems

Technology

- Model repair process enterprise
- Develop analytical tool box
- Implement advanced manufacturing concept
- Develop automated blade tracking system

Benefits to the War Fighter

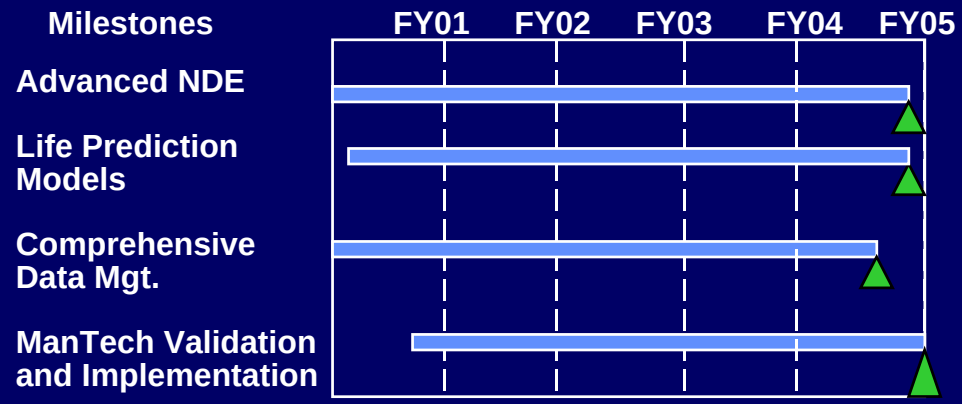
- For F100 engine low pressure stage 1 nozzle and stator:
  - Repair process travel distance reduced from 9 miles to 2 miles
  - Flow days reduced from 111 days to 55 days for nozzle and from 90 days to 15 days for stator
  - Net cost avoidance of $21.5M over ten years
- Similar payoff for other components

Engine Rotor Life Extension (ERLE)

AFRL/ML Bruce Rasmussen, DSN 785-9822

Cost Avoidance through Life Extension

Technology Investment Schedule — As of 6 April 01



62102F ($M)	3.36	2.52	2.10	2.30	3.7
63112F ($M)	0.68	1.99	1.76	2.16	1.66
65502F ($M)	0.95	0.75			
DARPA ($M)	0.75				
TESC ($M)	6.50				
PRAM ($M)	0.35				
78011F ($M)	0.39	3.74	7.47	7.55	3.57
(Burdened)Total	12.98	9.00	11.33	12.01	8.93

Description

- Develop,Validate and Implement advanced life management tools and practices that increase safety and extend useful of critical engine components in partnership with OC-ALC

Technologies

- Life Prediction, Non-Destructive Evaluation, Data Fusion, and Repair Technologies

Benefits to the War Fighter

- Increased safety through improved inspections and more accurate life prediction
- Improved readiness through reduced depot overhaul time and cost
- Reduced maintenance and associated rework
- Cost Avoidance over $600M (FY05-FY10)

Laser Shock Peening (LSP) for Aircraft Structure

AFRL/ML, David W. See, DSN 784-4387

Technology Investment Schedule — As of 4 Apr 2001

	Prior	01	02	Total
ManTech for Affordable LSP				
Rapid Laser Shock Peening Development				
LSP of F119 IBRs				
LSP Demonstration for High Strength Affordable Castings				
Engine Technology Availability				
Funding ($M)	5.3	1.8		7.1
MT (7.8,SBIR, RRPI, AMTFDII				
LSPT (Cost Share)	0.8	0.4		1.2

Description

- Develop laser peening for fracture prevention in fatigue and corrosion-critical aircraft structures.
- Increase the reliability of structural repairs.
- Mobile laser peening for aircraft repairs in depot.

Technology

- Laser peening produces deep compressive residual stresses into metal surfaces to significantly inhibit fatigue crack initiation and propagation.

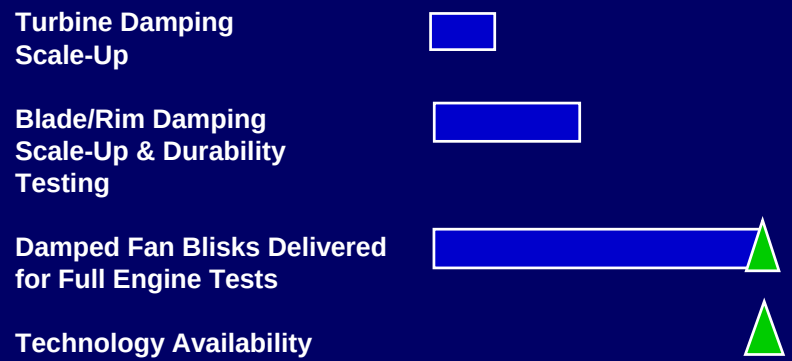
Benefits to the War Fighter

- LSP process ensures no crack growth from FOD in fan and compressor blade applications
- Implemented on F101 and F110: Working implementation on F119 (May 01)
- Fatigue prevention in fracture critical aircraft structure
- Improved reliability of aging aircraft parts

ManTech High Cycle Fatigue/Damping Technologies

AFRL/ML Carl M. Lombard DSN 674-4388

Technology Investment Schedule As of 6 Apr 2001



Funding ($M)

7.8 (ManTech)	0	.500	1.000	.900	.100
DUST	.250	0	0	0	0
Industry	.250	2.000	1.750	9.00	.100

Description

- Scale-up and engine demonstrate affordable manufacturing processes for advanced damping systems to reduce resonant vibration induced high cycle fatigue in turbine engine blades.

Technology

- Friction dampers, viscoelastic material (VEM) blade constrained layer damping systems, VEM rim dampers, hard coatings, and air dampers.

Benefits to the War Fighter

- Reduced HCF-related, non-recoverable, in-flight shutdowns by 50%
- Reduce total engine maintenance costs by 15%
- Increased engine performance and efficiencies
  - Allows greater use of advanced engine designs

Next Generation Transparency (NGT) Program

AFRL/ML, Bob McCarty, DSN 674-4595

Technology Investment Schedule — As of 29 Jan 01

	Prior	FY01	FY02
Requirements Definition			
Subscale Manufacturing and Testing			
Final Design of Tool			
Full Scale Article Manufacturing			
Full Scale Article Coating & Testing			
Tech Availability			

Funding ($M) -	Prior	FY01	FY02
6.2	1.26		
6.3	0.51	0.69	
7.8	1.10	0.20	0.20
DARPA	1.02		
Boeing	1.95	1.00	0.85

Description

- Demonstrate Affordable Frameless Transparency Technology Integration for Fighter/Attack Aircraft
- Full Scale Tests for Safety-of-Flight Compliance

Technology

- Direct Forming, Injection Molding
- Explosive Severance for Crew Escape

Benefits to the War Fighter

- 80% Reduction in Total Ownership Costs
  - •Top Rated Affordability Pilot Program
- Reduce Transparency Weight by 20%
- Replacement During Integrated Combat Turn
- Reduce Parts Count by 90%
- Precision Shape for LO
- Precision Optics for Helmet Mounted Display

MANTECH Electronic Parts Obsolescence Initiative

AFRL/ML Tony Bumbalough, DSN 674-4594

Technology Investment Schedule — As of 12 Feb 2001

	Prior	01	02	03	04	05
Enhanced Commercial Tools • Decision Making • Re-engineering						
Application of Commercially Manufactured Electronics • Life Prediction Tools • Access to Multiple Foundries						
Pilot Validation Demonstrations • Technical, Business Practices • Life Cycle Cost Modeling						
Technology Availability						
Funding ($M) – 7.8		9.5	4.9	3.8	2.1	.2

Description

- Develop technologies to improve obsolescence management to ensure mission readiness and increase the fielded life of weapons systems at an affordable cost

Technology

- Proactive decision management tools & business practices; physics of failure reliability prediction; re-engineering tools; life cycle cost modeling

Benefits to the War Fighter

- Ability to efficiently insert current/new technology
- Ability to efficiently respond to loss of supplier base or discontinuance of specific product line
- Ability to identify implement the most affordable obsolescence solutions
  - Substantial reduction in support costs

R&D Laboratory

Advanced Aircraft Corrosion Protection

AFRL/ML Steve Szaruga DSN 785-9064

Technology Investment Schedule (FY) — As of 13 Feb 01

	Prior	01
Funding ($M) – 6.2	.99	.68
DARPA/AFOSR ($M)	.82	.40

Description

- Product: Corrosion protection systems with long life topcoat and environmentally safe, non-chrome corrosion protection (sol-gel) demo'ed in a depot environment

Technology

- Advanced performance topcoat with service life of 5-8 yr (PDM to PDM)
- Non-chrome sol-gel based corrosion resistant surface treatments

Benefits to the War Fighter

- Supports ACC MNS/ORD "Advanced Aircraft Coating Capability" (MNS CAF/AMC/AETC/ AFSOC/AFMC 712-97)
- Elimination of corrosion protection related hazardous wastes and materials
- Reduced depot flow time and related maintenance costs

Chemical Abatement Treatments for Corrosion

AFRL/ML Deborah Peeler, DSN 785-4251

Technology Investment Schedule — As of 13 Mar 01

Milestones	FY01	FY02	FY03
Program Schedule			
Transition Test Capability: UVA To AFRL			
Aircraft Application and Tracking			
Laboratory Testing Fielded CPC			
Crack Inhibition:Selection and Fatigue Testing			
TAD			▲
Funding 63112F ($M)		0.35	0.26

Description

- Test and transition corrosion suppression technologies to the warfighter

Technology

- Establish corrosion prevention compounds (CPC) testing capability within AFRL/MLSA
- Determine corrosion growth rates for in-service suppression/establish laboratory correlation
- Develop CPC application and inspection protocols
- Establish effect of selected inhibitors on crack growth rates

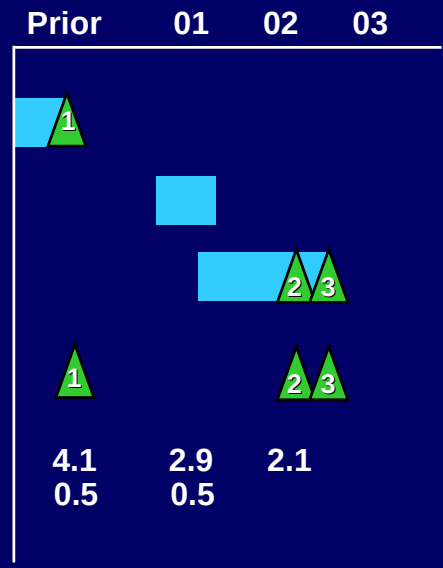
Benefits to the War Fighter

- Assess risk and safely defer selected corrosion maintenance until structurally necessary and/or convenient
- Establish of application and inspection intervals for CPC temporary repairs quantified
- Develop tech order data for implementation of CPC application into field supportable maintenance plan (FSMP)
- Quantify the effect of inhibition on crack growth rates

Corrosion Effects on Structural Integrity

AFRL/VA Mike Ziegler, DSN 785-3526

Technology Investment Schedule (FY) As of 28 Mar 01



Stress Corrosion Cracking Guidelines
Model Development & Element Testing
Component Demonstration and Model Verification

Technology Availability Dates

Funding ($M) - 6.3
NAVY

Product Description

1. Stress Corrosion Cracking Guidelines - Delivered
2. Structural Integrity (Corrosion/Fatigue) Model - Framework Delivered
3. Structural Integrity Tool Set-Prediction Capability for Lap Joints delivered, Handbooks & Inspection Capability Demo

Technologies

- Incorporate interaction of Corrosion with Structural Integrity -- Implement into Aircraft Structural Integrity Program
- Implement ability to predict and manage corrosion damage

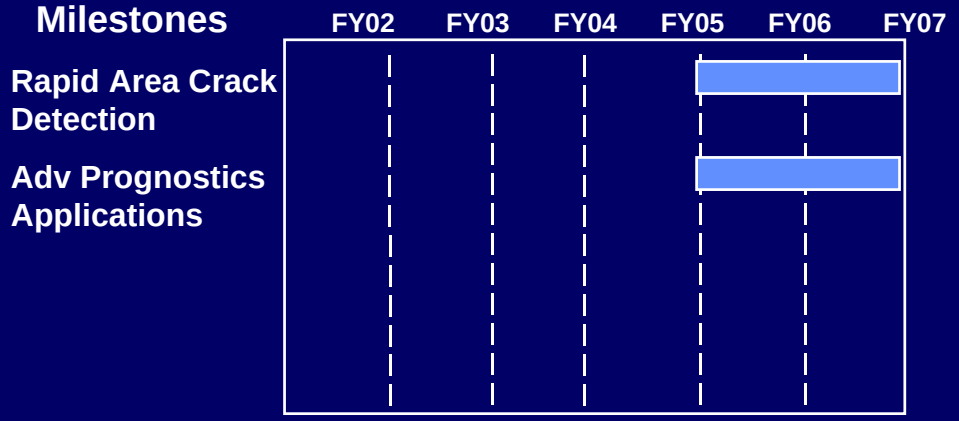
Benefits to the War Fighter

- Increase Operational Readiness
- Maintain Safety
- Reduce Operations and Support Cost
  - Reduced Maintenance Actions
  - Extend Structural Life
  - Reduce Cost of Maintenance of C- 130, C-141, KC-135, C-5, F-15, F-16, A-10 …

Aircraft Structures NDE Technologies

AFRL/ML Tom Moran, DSN 785-9800

Technology Investment Schedule Milestones — As of 13 Mar 01



Funding 63112F ($M)	2.27	2.31

Description

- Non-Destructive Inspection (NDI) methods targeted at multi-layer crack detection and quantification
- Periodic delivery of NDI methods to detect and quantify corrosion

Technology

- Leverage technologies from "Advanced NDE for Aging Structures" ATD & Prognostics and Vehicle Health Monitoring programs.
- Technology insertions from Neural Networking and Artificial Intelligence efforts will assist in data interpretation for wide area detection schemes.

Benefits to the War Fighter

- Ability to determine the integrity of aging aircraft structures
- Technologies to rapidly and quantitatively determine the severity (depth and area) of structural degradation from cracks and corrosion
- Increased safety through detection and elimination of detrimental multi-site damage
- Elimination of unnecessary teardown of structures in depot maintenance

Advanced NDE for Aging Structures

AFRL/ML Tom Moran, DSN 785-9800

Technology Investment Schedule (FY) As of 28 Mar 01

	Prior	01	02	03	04	05
Corrosion Methods Assessment / Development		A		B		C
Crack Detection Assessment / Development		D				E
Technology Availability Dates						
6.2 Funding ($M)	.85	1.22	1.13	1.02	1.10	.93
6.3 Funding ($M)	.71	.48	.83	1.68	1.60	1.10

Description

- Periodic delivery of NDI methods to detect and quantify corrosion
- NDI methods targeted at multi-layer crack detection and quantification

Technology

- NDE methods with rapid, large area scanning capability
- Probability of Detection methodology
- Computer simulation models for NDE methodologies

Benefits to the War Fighter

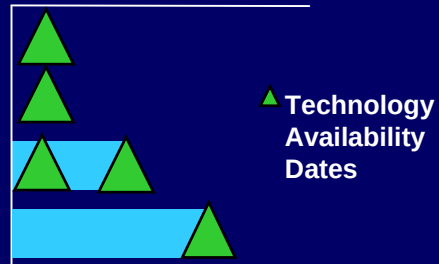
- Increased safety through detection and elimination of detrimental multi-site damage
- Improved readiness through reduction of time in depot - increased aircraft availability
- Reduced maintenance costs
- Eliminate unnecessary teardown

Bonded Repair Capability Enhancements

AFRL/VA Mike Ziegler, DSN 785-3526

Technology Investment Schedule (FY) As of 22 Mar 2001

Milestones	Prior	01	02
Expanded Materials Database			
Updated Bonded Repair Guidelines			
Advanced Metal Surface Prep			
Validated D&A Models/Software			
6.2 Funding ($M)	0.3	0.3	
6.3 Funding ($M)	1.6	2.1	1.9
6.3B (CEV) Funding ($M)	0.1	0.2	
SERDP Funding ($M)	0.9	0.6	



Description

- Design/Analysis (D&A) Methods and Materials/Processes (M&P) for Bonded Repairs
- Validation of Models and Processes
- Documented Guidelines/Procedures and Repair Materials Data

Technologies

- PC-based Software Tools for Design & Analysis
- Sol-gel Processes for Metal Surface Preparation

Benefits to the War Fighter

- Decreased Maintenance and Support Costs and Increased Aircraft Availability
  - Reduced Design and Analysis Time
  - Reduced Repair Installation Time
  - Improved Repair Reliability/Effectiveness
  - Reduced Use of Hazardous Materials

Non-Line of Sight Chrome Replacement Technologies

AFRL/ML Tom Naguy, DSN 986-5709

Technology Investment Schedule — As of 04 APR 2001

	Prior	01	02	03	04
Non-Line of Sight Hard Chrome Replacements					
Nano-Particle Deposition Electroplating as an Alternative to Chrome/Nickel Plating					
Funding ($M) –					
62102F		. 540			
CEV		. 295	.300	.250	
63859F				.350	.350

Description

- Develop HVOF alternatives for non-line-of-sight coating application

Technology

- Supplements HVOF Thermal Spray Technology by developing and demonstrating chemical and electrochemical processes for chrome replacement
- Investigate the deposition of nano-scale particles in electroplating as a potential alternative for chrome and nickel NLOS plating applications

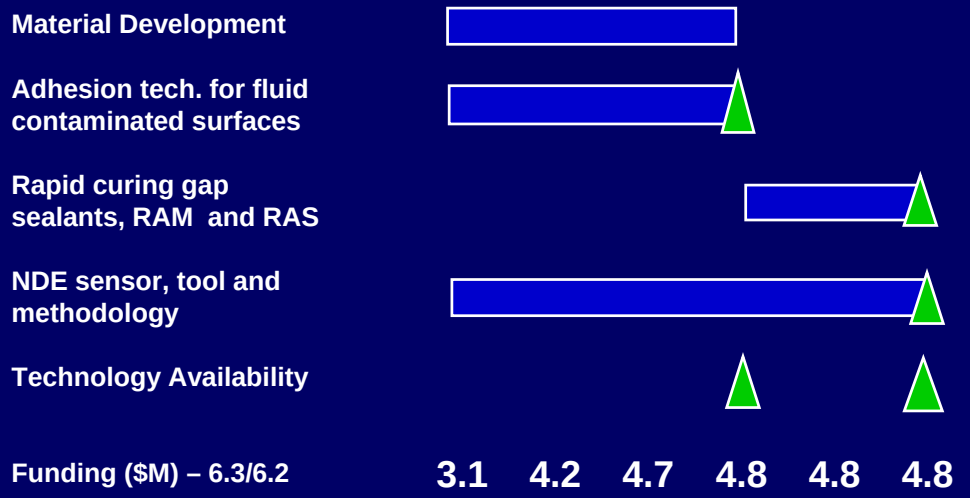
Benefits to the War Fighter

- Improved metal plating properties for NLOS requirements
- Reduced exposure and health hazards to personnel involved in chrome and nickel plating operations
- Reduced cost of environmental compliance at AF depots
- Reduced hazardous wastes and hazardous materials usage at Air Force depots

Deployed AEF Low Observable Repair Technologies

AFRL/ML Doug Carter, DSN 785-7483

Technology Investment Schedule — As of 12 Feb 2001



Description

- Develop technologies to quickly repair aircraft low observable treatments within a deployed Air Expeditionary Force environment to rapidly return aircraft to combat.

Technology

- Adhesion technology for contaminated surfaces, generic rapid cure materials and processes, and hand-held nondestructive evaluation equipment.

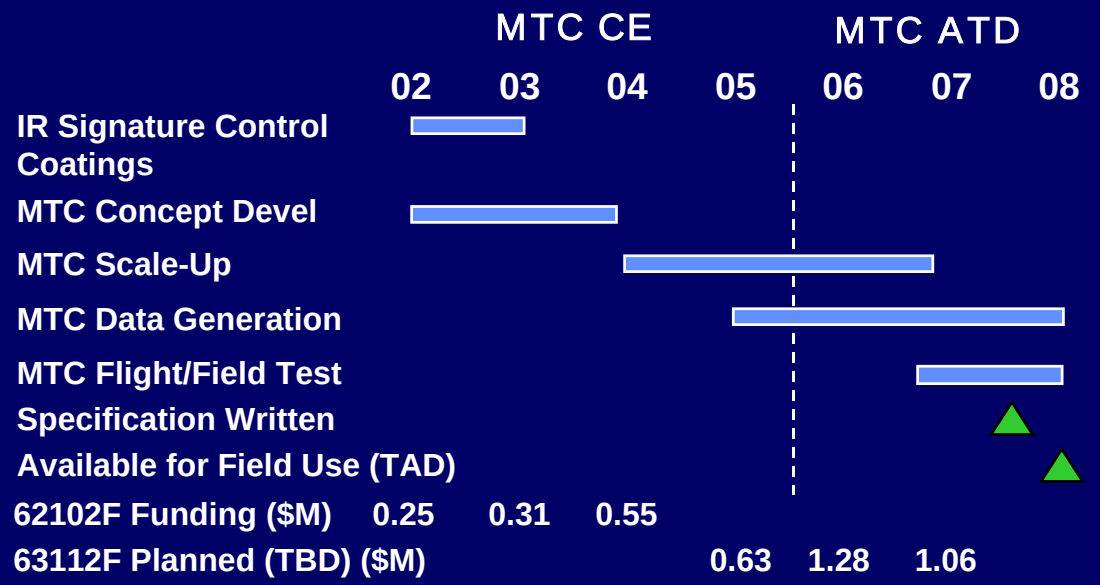
Benefits to the War Fighter

- Capability to apply low observable treatments to aircraft surfaces that are fluid contaminated
- Capability to rapidly repair and cure low observable treatments
- Rapid identification and inspection of damage and assessment of signature after repair

Mission Tailorable Coatings

AFRL/ML Steve Szaruga, DSN 785-9064

Preliminary Technology Investment Schedule As of: 31 Jan 01



Description

A field applicable topcoat that will tailor an aircraft's optical (visible and infrared) signature to specific mission requirements

Technology

Field kit utilizing spectrally tailored pigments combined with a quick cure, compatible binder that can be added to MIL-spec topcoats

Benefits to the War Fighter

- Supports "Adv. Aircraft Coating Capability" ORD (CAF-712-97-1-A)
- Increased survivability against air and ground based optical queuing and imaging threats
- Reduced logistic burden: additive to conventional paint; utilize brush-roll and spray application
- Applicable to all classes of aircraft